

CLAIMS

We claim:

1. An apparatus for stacking sheets from a starwheel assembly comprising:

5 a barrier located at least partially within the starwheel assembly to discharge the sheets from the starwheel assembly;

a first separator finger movable from a retracted position with respect to the sheets within the starwheel assembly to an extended position between first and second adjacent sheets within the starwheel assembly, the first separator finger movable to support the first sheet to begin a first stack upon the first separator finger and to separate the first sheet from the second sheet completing another stack; and

10 a second separator finger movable independently of the first separator finger.

15 2. The apparatus of claim 1, further comprising:

a first actuator coupled to the first separator finger, the first actuator actuatable to move the first separator finger; and

20 a second actuator coupled to the second separator finger, the second actuator actuatable to move the second separator finger;

wherein the first and second actuators are controllable independently of one another to move the first and second separator fingers independently of one another.

25 3. The apparatus of claim 2, further comprising a third actuator coupled to the first separator finger, the third actuator actuatable to move the first separator finger in a direction different from the first actuator, the first separator finger movable by actuation of the first and third actuators.

30 4. The apparatus of claim 3, wherein the first and third actuators are independently controllable to move the first separator finger.

5. The apparatus of claim 1, wherein the barrier is radially aligned with the starwheel assembly.

6. The apparatus of claim 1, wherein the first separator finger projects in a direction substantially perpendicular to the barrier.

5 7. The apparatus of claim 1, wherein the starwheel rotates in a direction, the first separator finger being movable opposite to the direction of rotation of the starwheel assembly.

10 8. The apparatus of claim 1, wherein the first separator finger is movable within a cylindrical volume defined by a periphery of the starwheel assembly.

15 9. The apparatus of claim 1, wherein the first separator finger is movable outside a cylindrical volume defined by a periphery of the starwheel assembly.

20 10. The apparatus of claim 1, wherein the barrier is coupled to the first separation finger.

25 11. The apparatus of claim 1, wherein the second separator finger is movable toward the starwheel assembly to receive the first stack from the first separator finger.

30 12. The apparatus of claim 11, wherein the second separator finger is movable away from the starwheel assembly to accommodate additional discharged sheets on the first stack.

35 13. The apparatus of claim 12, wherein the first separator finger is movable to an extended position between third and fourth adjacent sheets within the starwheel assembly, the first separator finger movable to support the third sheet to begin a second stack upon the first separator finger and to separate the third sheet from the fourth sheet completing the first stack.

14. The apparatus of claim 13, further comprising a conveyor positioned to receive the first stack, the conveyor movable to carry the first stack away from the starwheel assembly.

5 15. The apparatus of claim 1, wherein the first separator finger is movable radially away from the starwheel assembly to accommodate additional discharged sheets on the first stack.

10 16. The apparatus of claim 15, wherein the second separator finger is movable from a retracted position with respect to the sheets within the starwheel assembly to an extended position between third and fourth adjacent sheets within the starwheel assembly, the second separator finger movable to support the third sheet to begin a second stack upon the second separator finger and to separate the third sheet from the fourth sheet completing the first stack on the first separator finger.

15 17. The apparatus of claim 16, further comprising a conveyor positioned to receive the first stack from the first separator finger, the conveyor movable to carry the first stack away from the starwheel assembly.

20 18. The apparatus of claim 17, wherein the second separator finger is movable radially away from the starwheel assembly to accommodate additional discharged sheets on the second stack.

25 19. The apparatus of claim 17, wherein the conveyer is positioned to receive the second stack from the second separator finger and to carry the second stack away from the starwheel assembly.

30 20. A method for stacking sheets from a starwheel assembly rotated about an axis, the method comprising:
feeding sheets to the starwheel assembly;
discharging sheets from the starwheel assembly with a barrier;
inserting a first separator finger between two adjacent sheets positioned within the starwheel assembly;

moving a second separator finger independently of the first separator finger; and

supporting a first sheet of the two adjacent sheets with the first separator finger, the first sheet beginning a first stack and a second sheet of the two adjacent sheets completing another stack.

21. The method of claim 20, wherein inserting the first separator finger includes actuating a first actuator coupled to the first separator finger.

22. The method of claim 21, wherein:
inserting a first separator finger further includes actuating a second actuator coupled to the first separator finger; and
the first and second actuators are actuatable to move the first separator finger in different directions.

23. The method of claim 22, wherein the first and second actuators are independently controllable.

24. The method of claim 20, further comprising moving the second separator finger toward the starwheel assembly to receive the first stack from the first separator finger.

25. The method of claim 24, further comprising:
moving the second separator finger and the first stack away from the starwheel assembly; and
supporting additional discharged sheets on the first stack after the second separator finger receives the first stack.

26. The method of claim 25, further comprising:
reinserting the first separator finger between a second set of two adjacent sheets positioned within the starwheel assembly; and
supporting a third sheet of the second set of two adjacent sheets with the first separator finger, the third sheet beginning a second stack, and a

fourth sheet of the second set of two adjacent sheets completing the first stack on the second separator finger.

27. The method of claim 26, further comprising:
transferring the first stack from the second separator finger to a conveyor; and
moving the first stack on the conveyor away from the starwheel assembly.

28. The method of claim 20, further comprising:
moving the first separator finger and the first sheet radially away from the starwheel assembly; and
supporting additional discharged sheets on the first sheet as the first separator finger and the first sheet move radially away from the starwheel assembly.

29. The method of claim 28, further comprising:
inserting the second separator finger between a second set of two adjacent sheets positioned within the starwheel assembly; and
supporting a third sheet of the second set of two adjacent sheets with the second separator finger, the third sheet beginning the second stack, and a fourth sheet of the second set of two adjacent sheets completing the first stack on the first separator finger.

30. The method of claim 29, further comprising:
transferring the first stack from the first separator finger to a conveyor; and
moving the first stack on the conveyor away from the starwheel assembly.

31. The method of claim 30, wherein transferring the first stack from the first separator finger to the conveyor includes passing fingers of the first separator finger through the conveyor.

32. The method of claim 30, wherein transferring the first stack from the first separator finger to the conveyor includes retracting fingers of the first separator finger behind the barrier.

5 33. The method of claim 30, further comprising:
moving the second separator finger radially away from the
starwheel assembly; and
supporting additional discharged sheets on the second stack after
the second separator finger moves radially away from the starwheel assembly.

10 34. The method of claim 33, further comprising:
transferring the second stack from the second separator finger to a
conveyor; and
moving the second stack on the conveyor away from the starwheel
15 assembly.

20 35. An apparatus for stacking sheets from a starwheel assembly
comprising:
a barrier located at least partially within the starwheel assembly to
discharge the sheets from the starwheel assembly; and
a separator finger movable to separate a stream of sheets fed by the
starwheel assembly, the separator finger having:
a vertical range of motion; and
a horizontal range of motion;
25 at least one actuator coupled to the separator finger, the at least one
actuator actuatable to move the separator finger; and
a controller coupled to the actuator, the at least one actuator
actuatable in a first manner under control of the controller to move the separator
finger in a first path and actuatable in a second manner under control of the
30 controller to move the separator finger in a second path different from the first
path.

36. The apparatus of claim 35, wherein;
at least two actuators are coupled to the separator finger and to the
controller; and
each of the at least two actuators are independently controllable by
the controller to move the separator finger.

37. The apparatus of claim 35, wherein the separator finger is movable
to any location within an area defined by the vertical range of motion and the
horizontal range of motion.

38. The apparatus of claim 37, wherein the separator finger is movable
to any location within the area with variable acceleration.

39. The apparatus of claim 37, wherein the area intersects a cylindrical
volume defined by a periphery of the starwheel assembly.

40. The apparatus of claim 35, wherein the separator finger is movable
from a retracted position with respect to sheets within the starwheel assembly to
an extended position between first and second adjacent sheets within the starwheel
assembly, the separator finger movable to support the first sheet to begin a first
stack upon the separator finger and to separate the first sheet from the second
sheet completing another stack.

41. The apparatus of claim 40, wherein the separator finger is movable
radially away from the starwheel assembly to accommodate additional discharged
sheets on the first stack.

42. The apparatus of claim 41, further comprising a conveyor adjacent
to the starwheel assembly, the conveyor movable toward the starwheel assembly
to receive the first stack from the separator finger and away from the starwheel
assembly to accommodate additional discharged sheets on the first stack.

43. The apparatus of claim 42, wherein the separator finger is movable to an extended position between a third and fourth adjacent sheets within the starwheel assembly, the separator finger movable to support the third sheet to begin a second stack upon the separator finger and to separate the third sheet from the fourth sheet completing the first stack on the movable conveyor.

44. The apparatus of claim 35, wherein the separator finger is a first separator finger, the apparatus further comprising a second separator finger movable to separate the stream of sheets fed by the starwheel assembly, the second separator finger having:

a second vertical range of motion; and

a second horizontal range of motion; and

at least one actuator coupled to the second separator finger, the at least one actuator coupled to the second separator finger actuatable to move the second separator finger;

wherein the controller is coupled to the actuator of the second separator finger, the actuator of the second separator finger actuatable in a first manner under control of the controller to move the second separator finger in a first path and actuatable in a second manner under control of the controller to move the second separator finger in a second path different from the first path.

45. The apparatus of claim 44, wherein the first vertical range of motion is substantially the same as the second vertical range of motion.

46. The apparatus of claim 45, wherein the first horizontal range of motion is substantially the same as the second horizontal range of motion.

47. The apparatus of claim 44, wherein the second separator finger is movable from a retracted position with respect to sheets within the starwheel assembly to an extended position between first and second adjacent sheets within the starwheel assembly, the second separator finger movable to support the first sheet to begin a first stack upon the second separator finger and to separate the first sheet from the second sheet completing another stack.

48. The apparatus of claim 47, wherein the second separator finger is movable toward the starwheel assembly to receive the first stack from the first separator finger.

5 49. The apparatus of claim 48, wherein the second separator finger is movable radially away from the starwheel assembly to accommodate additional discharged sheets on the first stack.

10 50. The apparatus of claim 49, wherein the first separator finger is movable to an extended position between third and fourth adjacent sheets within the starwheel assembly, the first separator finger movable to support the third sheet to begin a second stack upon the first separator finger and to separate the third sheet from the fourth sheet completing the first stack on the second separator finger.

15 51. The apparatus of claim 50, further comprising a conveyor positioned to receive the first stack from the second separator finger and to carry the first stack away from the starwheel assembly.

20 52. The apparatus of claim 44, wherein the first separator finger is movable radially away from the starwheel assembly to accommodate additional discharged sheets stacked thereon.

25 53. The apparatus of claim 52, wherein the first separator finger is movable from a retracted position with respect to the sheets within the starwheel assembly to an extended position between a third and fourth adjacent sheets within the starwheel assembly, the first separator finger movable to support the third sheet to begin a second stack upon the first separator finger and to separate the third sheet from the fourth sheet completing the first stack on the second separator finger.

30 54. The apparatus of claim 53, further comprising a conveyor positioned to receive the first stack from the second separator finger and to carry the first stack away from the starwheel assembly.

55. The apparatus of claim 54, wherein the second separator finger is movable radially away from the starwheel assembly to accommodate additional discharged sheets thereon.

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56. The apparatus of claim 55, wherein the conveyer is positioned to receive the second stack from the first separator finger and to carry the second stack away from the starwheel assembly.

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57. A method for stacking sheets from a starwheel assembly rotated about an axis, the method comprising:

providing a separator finger movable a vertical distance and a horizontal distance;

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providing an actuator coupled to the separator finger;

providing a controller with associated programming coupled to the actuator, the programming at least partially defining a manner in which the actuator is actuated to move the separator finger;

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feeding sheets to the starwheel assembly;

discharging sheets from the starwheel assembly with a barrier;

transmitting at least one signal from the controller to the actuator;

actuating the actuator responsive to transmission of the at least one signal from the controller to the actuator; and

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moving the separator finger in the first manner defined at least in part by the programming of the controller to separate sheets within the starwheel assembly.

58. The method of claim 57, wherein the programming of the controller can be changed to move the separator finger in different manners.

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59. The method of claim 58, further comprising:

changing the programming of the controller to define new programming of the controller; and

moving the separator finger in a second manner defined at least in part by the new programming of the controller.

60. The method of claim 57, wherein moving the separator finger includes moving the separator finger to any location within an area defined by the vertical distance and the horizontal distance.

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61. The method of claim 60, wherein moving the separator finger includes moving the separator finger to any location within the area with variable acceleration.

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62. The method of claim 61, further comprising moving the separator finger into and out of a cylindrical volume defined by the periphery of the starwheel assembly.

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63. The method of claim 57, further comprising:
inserting the separator finger between two adjacent sheets positioned within the starwheel assembly; and
supporting a first sheet of the two adjacent sheets of a first stack with the separator finger, the first sheet beginning the first stack and a second sheet of the two adjacent sheets completing another stack.

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64. The method of claim 63, further comprising:
moving the separator finger and the first sheet radially away from the starwheel assembly; and
supporting additional discharged sheets on the first sheet as the separator finger and the first sheet move radially away from the starwheel assembly.

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65. The method of claim 64, further comprising:
moving a conveyor toward the starwheel assembly to receive the first stack from the separator finger;
moving the conveyor and the first stack away from the starwheel assembly; and
supporting additional discharged sheets on the first stack after the conveyor receives the first stack.

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66. The method of claim 65, further comprising:
reinserting the separator finger between a second set of two
adjacent sheets in the starwheel assembly; and
5 supporting a third sheet of the second set of two adjacent sheets of
a second stack with the separator finger, the third sheet beginning the second stack
and a fourth sheet of the second set of two adjacent sheets completing the first
stack on the movable conveyor.

10 67. The method of claim 57, further comprising:
providing a second separator finger movable a second vertical
distance and a second horizontal distance;
providing a second actuator coupled to the second separator finger;
providing the controller with associated programming coupled to
15 the second actuator, the programming at least partially defining a manner in which
the second actuator is actuated to move the second separator finger;
transmitting at least one signal from the controller to the second
actuator;
actuating the second actuator responsive to transmission of the at
20 least one signal from the controller to the second actuator; and
moving the second separator finger in the first manner defined at
least in part by the programming of the controller to separate sheets within the
starwheel assembly.

25 68. The method of claim 67, further comprising:
inserting the first separator finger between two adjacent sheets
positioned within the starwheel assembly; and
supporting a first sheet of the two adjacent sheets of a first stack
with the first separator finger, the first sheet beginning the first stack and a second
30 sheet of the two adjacent sheets completing another stack.

69. The method of claim 68, further comprising:
moving the second separator finger toward the starwheel assembly
to receive the first stack from the first separator finger.

70. The method of claim 69, further comprising:
moving the second separator finger and the first stack away from
the starwheel assembly; and
5 supporting additional discharged sheets on the first stack after the
second separator finger receives the first stack.

71. The method of claim 70, further comprising:
reinserting the first separator finger between a second set of two
10 adjacent sheets positioned within the starwheel assembly; and
supporting a third sheet of the second set of two adjacent sheets of
a second stack with the first separator finger, the third sheet beginning the second
stack and a fourth sheet of the second set of two adjacent sheets completing the
first stack on the second separator finger.

72. The method of claim 71, further comprising:
transferring the first stack from the second separator finger to a
conveyor; and
20 moving the first stack on the conveyor away from the starwheel
assembly.

73. The method of claim 68, further comprising:
moving the first separator finger and the first sheet radially away
from the starwheel assembly; and
25 supporting additional discharged sheets on the first sheet as the first
separator finger and the first sheet move radially away from the starwheel
assembly.

74. The method of claim 73, further comprising:
30 inserting the second separator finger between a second set of two
adjacent sheets positioned within the starwheel assembly; and
supporting a third sheet of the second set of two adjacent sheets of
a second stack with the second separator finger, the third sheet beginning the

second stack and a fourth sheet of the second set of two adjacent sheets completing the first stack on the first separator finger.

5 75. The method of claim 74, further comprising:
 transferring the first stack from the first separator finger to a
 conveyor; and
 moving the first stack on the conveyor away from the starwheel
 assembly.

10 76. The method of claim 75, further comprising:
 moving the second separator finger and the third sheet radially
 away from the starwheel assembly; and
 supporting additional discharged sheets on the second stack after
15 the second separator finger and the third sheet move radially away from the
 starwheel assembly.

20 77. The method of claim 76, further comprising:
 transferring the second stack from the second separator finger to a
 conveyor; and
 moving the second stack on the conveyor away from the starwheel
 assembly.

25 78. The method of claim 65, further comprising starting the conveyor
 from a rest position to convey the first stack away from the starwheel assembly
 after the conveyor receives the first stack.

30 79. The method of claim 57, further comprising:
 transferring a first partially completed stack from the separator
 finger to a conveyor; and
 supporting additional discharged sheets on the conveyor after the
 conveyor receives the first stack.

80. The method of claim 79, further comprising moving the conveyor away from the starwheel assembly to accommodate additional sheets upon the first partially completed stack.

5 81. A sheet stacking apparatus for stacking sheets from a starwheel assembly, the sheet stacking apparatus, comprising:

a separator finger;

a first actuator coupled to the separator finger, the first actuator actuatable to move the separator finger in a first direction; and

10 a second actuator coupled to the separator finger, the second actuator actuatable to move the separator finger in a second direction;

the separator finger movable by at least one of the first and second actuators from a retracted position with respect to sheets within the starwheel assembly to an extended position between first and second adjacent sheets within the starwheel assembly, the separator finger movable to support the first sheet to begin a first stack upon the first separator finger and to separate the first sheet from the second sheet completing another stack.

15 82. The apparatus of claim 81, wherein the first and second actuators are independently controllable.

83. The apparatus of claim 81, wherein the first and second directions are substantially perpendicular to one another.

20 84. The apparatus of claim 81, wherein the first direction is substantially horizontal.

85. The apparatus of claim 81, wherein the first direction is substantially vertical.

30 86. The apparatus of claim 85, wherein the second direction is substantially horizontal.

5 87. The apparatus of claim 81, further comprising a controller coupled to the first and second actuators, the controller having associated programming defining a path in which the separator finger moves by actuation of the first and second actuators, wherein the programming can be changed to change the path of the separator finger.

88. A method of stacking sheets of product discharged from a starwheel, the method comprising:

10 actuating a first actuator coupled to a separator finger;
 moving the separator in a first direction responsive to actuation of the first actuator;
 actuating a second actuator coupled to the separator finger;
 moving the separator finger in a second direction different from the first direction responsive to actuation of the second actuator; and
15 separating sheets in the starwheel by moving the separator finger in at least one of the first and second directions.

20 89. The method of claim 88, wherein at least part of moving the separator in a first direction and moving the separator in a second direction occurs substantially simultaneously.

90. The method of claim 88, wherein the first actuator is actuated independently of the second actuator.

25 91. The method of claim 88, wherein the first and second directions are substantially perpendicular to one another.

92. The method of claim 88, wherein the first direction is substantially horizontal.

30 93. The method of claim 88, wherein the first direction is substantially vertical.

94. The method of claim 93, wherein the second direction is substantially horizontal.

95. The method of claim 94, further comprising:
controlling at least one of the first and second actuators with a controller having programming at least partially defining a first path taken by the separator finger; and
changing the programming of the controller to at least partially define a second path taken by the separator different from the first path.

96. An apparatus for moving stacks of product discharged from a stacking device, the apparatus comprising:
a first conveyor movable at a first speed, the first conveyor including:
an upstream end adjacent to the stacking device and positioned to receive product from the stacking device; and
a running speed; and
a second conveyor movable at a second speed, the second conveyor including:
an upstream end adjacent to the stacking device and positioned to receive product from the stacking device; and
a running speed;

wherein the running speed of the first conveyor is faster than the running speed of the second conveyor to move stacks of product on the first conveyor away from the stacking device at a faster speed than stacks of product on the second conveyor.

97. The apparatus of claim 96, further comprising a third conveyor located adjacent to the first and second conveyors, wherein:
the first and second conveyors each have respective downstream ends located adjacent to the third conveyor.

98. The apparatus of claim 97, further comprising a backstop adjacent to the third conveyor, the backstop positioned to limit stack movement in a

direction toward the backstop when the stacks are at least partially positioned on the third conveyor.

5 99. The apparatus of claim 97, wherein the third conveyor is a paddle table having at least one paddle extending from the paddle table and movable relative to the first and second conveyors.

10 100. The apparatus of claim 99, wherein the at least one paddle and the first and second conveyors are timed such that the first stack is moved by a paddle before the second stack is moved by a paddle.

15 101. The apparatus of claim 100, wherein the first stack and second stack are moved by consecutive paddles of the third conveyor.

20 102. The apparatus of claim 100, wherein the first conveyor is separated from the second conveyor in the direction motion of the plurality of paddles.

25 103. The apparatus of claim 96, further comprising a motor driving the first and second conveyors.

30 104. The apparatus of claim 103, further comprising a first gear coupled between the motor and the first conveyor and a second gear coupled between the motor and the second conveyor, wherein the gear ratio between the motor and the first gear is different than the gear ratio between the motor and the second gear.

105. The apparatus of claim 96, further comprising a first separator finger and a second separator finger, wherein the first separator finger is movable to transfer the first stack to the first conveyor and the second separator finger is movable to transfer the second stack to the second conveyor.

106. The apparatus of claim 105, wherein the first and second conveyors are positioned to receive the first and second stacks at substantially the same time.

107. The apparatus of claim 105, wherein:

the first separator finger is movable through the first conveyor to transfer the first stack to the first conveyor; and

the second separator finger is movable through the second conveyor to transfer the second stack to the second conveyor.

108. The apparatus of claim 107, wherein the first and second conveyors run in substantially the same direction.

109. A method of moving stacks of product discharged from a stacking device, the method comprising:

discharging a first stack onto an upstream end of a first conveyor;

discharging a second stack onto an upstream end of a second conveyor;

moving the first and second stacks from the upstream ends of the first and second conveyors at substantially the same time;

moving the first stack with the first conveyor toward the downstream end of the first conveyor at a first speed; and

moving the second stack with the second conveyor at a second speed slower than the first speed of the first stack.

110. The method of claim 109, further comprising:

receiving the first stack on a third conveyor; and

receiving the second stack on the third conveyor after the first stack is at least partially received on the third conveyor.

111. The method of claim 110, further comprising contacting a backstop with the first and second stacks when the first and second stacks are at least partially received on the third conveyor.

112. The method of claim 110, further comprising moving the third conveyor in a transverse direction relative to the first and second conveyors.

113. The method of claim 109, further comprising:

moving the first stack with the third conveyor;

moving the second stack with the third conveyor after the first stack is moved.

5 114. The method of claim 113, wherein the first and second stacks are moved in substantially the same direction.

115. The method of claim 109, further comprising driving the first and second conveyors with a motor.

10 116. The method of claim 115, further comprising:
driving a first gear located between the motor and the first conveyor; and
driving a second gear located between the motor and the second conveyor,
wherein the gear ratio between the motor and the first gear is different than the
gear ratio between the motor and the second gear.

15 117. The method of claim 109, wherein discharging a first stack and discharging a second stack include passing a first separator finger through the upstream end of the conveyor and passing a second separator finger through the upstream end of the second conveyor.

20 118. The method of claim 117, wherein the first and second stacks are discharged at substantially the same time.